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Effects of Extraction Methods and Transesterification Temperature on the Qualities of Biodiesel from Jatropha Seed's Oil

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ABSTRACT: *Jatropha curcas oil has been considered a promising alternative fuel for compressing ignition engines. However, its qualities and utilizations have been affected by so many factors such as extraction methods, temperatures, reactants, etc. As a result, this work was aimed at studying the effects of extraction methods and transesterification temperature on the qualities of biodiesel from jatropha oil seeds. Three methods of extraction (milling hydraulic, and defatting; milling, toasting, and defatting: and sand roasting, dehulling, milling and defatting) were employed to produce the three different samples A, B, and C respectively. The yields of the oils obtained were measured. Oil qualities of the oil like: specific gravity, viscosity, free fatty acid, saponification value, peroxide value, pH and iodine value content of the oil were determined. The extracted oils were subjected to transesterification process at a various temperature by treatment with ethanol using potassium hydroxide as catalyst. Average yield of biodiesel was 70.62 %, 74.33% and 79.41% of raw oil from sample A, B and C respectively. The specific gravity, viscosity, free fatty acid, saponification value, peroxide value, pH and iodine value content of the oil of sample were A (0.904, 3.240mm2/s, 0.431% ,64.80mg/kg, 2.00mg/kg, 7.38 and 140.61, respectively); sample B (0.903, 3.130mm2/s, 0.423%, 58.91mg/kg, 11.00mg/kg, 7.02 and 55.33, respectively); sample C (0.908, 3.324mm2/s, 0.368%, 52.73mg/kg, 2.00mg/kg, 8.50 and 143.65 respectively). The result revealed that different extraction methods and transesterification temperature have actually affected the quantity and quality of biodiesel produced from Jatropha oil seeds. Processing of the oil seeds by roasting dehulling, milling and defatting and transesterification at 70^{0}C gave the highest oil yield and the most acceptable chemical properties.*

I. INTRODUCTION

Jatropha curcas is a multi-purpose drought resistant perennial plant belonging to Euphorbiaceous family. The seed of Jatropha contains viscous oil which can be used to make soap, candle, fertilizer, charcoal, pesticides, medicinal and energy source. It can also be used as food by boiling and roasting the nut for consumption. Jatropha seeds shells when available due to large plantation and processing can be a good source of charcoal or energy. The oil obtainable from Jatropha seed can also be used for skin care. All parts of Jatropha seed, leaves and bark can be used in traditional medicine and for veterinary purposes (Daiziel, 1955). The oil can be applied for the treatment of eczema, skin diseases, and to soothe rheumatic pain (Heller, 1996). Its stem can be used as a natural tooth paste and brush. Also, latex from stem is used as natural pesticides and wound healing. Jatropha oil is also a source of biodiesel fuel in a diesel engine. In addition to economic importance of Jatropha, it is used to protect crops from livestock for them to feed on because of the toxic substance called curcin and also to reduce wind erosion and pressure on timber resources. It provides income and organic fertilizer to increase crop yields as well as being an ecologically friendly source of alternative energy to rural farmers. The extraction of Jatropha oil can be done manually which makes it drudgery and time consuming. The most common method of extracting edible oil from oil seeds is by mechanical pressing of oil seeds. This method ensures that there is no contamination in the process of extraction although it has low efficiency but high quality. The possible income from oil extraction is therefore enough to justify the relatively high cost of settling up and running a small-scale oil milling business. The use of expelling machine by mechanical means to extract oil from Jatropha seeds is said to be appropriate and these have been reported by several researchers (Ramesh et al, 2002). However, the qualities have been affected by so many factors which have great influence on its utilizations. As a result, this work was aimed at studying the effects of extraction methods and temperatures on the quantities and qualities of biodiesel from jatropha oil seeds.

II. MATERIALS AND METHOD

Materials: The materials used for this research include: *Jatropha* seeds, ethanol, Potassium hydroxide, distilled water and Phenolphthalein solution. Laboratory wares used were obtained from ……………….

Methods: Three different samples of Jatropha oil were obtained using different methods. The first sample was milled and defatted hydraulically (sample A), the second was roasted, milled and defatted hydraulically (sample B), the third sample was dehulled, milled, and defatted hydraulically (sample C). Ethanol was filtered to remove all the dirt particles, this is because ethanol must be free from water if possible water content must be less than 1%. The obtained oils samples were subjected to transetherification at difference temperatures by treatment with ethanol using potassium hydroxide as a catalyst.

Analysis
Yield: The yield of the oil was calculated thus:
$Y=(V_e/V_r)x100\%$. Where: Y = Yield of the esters (%), V_e = Volume ethyl esters produced (mls), V_r = Volume of raw oil (mls).

Specific gravity: Specific gravity was measured as the ratio of the density of the sample to density of water at a specific temperature.

Viscosity: Viscosity of the sample was determined as the measurement of flow ability at definite temperature. It was the resistance to flow exhibited by fuel blend.

pH: The pH electrodes were standardized with buffer solution and electrode immersed into the sample and the pH value were read and recorded.

Peroxide value: The peroxide value was preferably carried out in subdue daylight.
Peroxide Value (Meq/kg) = Titre value
55.84 x Wt. of the sample

Iodine value: The method specified by ISO 3961 was used. The iodine value (I.V) is given by the expression.
$I.V = \frac{12.69 \text{ X } C (V_1 - V_2)}{W}$
Where C = Concentration of sodium thiosulphate used. V_1 = Volume of Sodium thiosulphate used for blank, V_2 = Volume of sodium thiosulphate used for determination, M = Mass of the sample

Saponification value: Indicators method was used as specified by ISO 3657 (1988).
The expression for saponification value (S.V) is given as
$S.V = 56.1 \text{ x } N (V_0 - V_1). M$
Where V_0 = the volume of the solution used for blank test, V_1 = the volume of the solution used for determination, N = actual normality of the HCL used, M = mass of the sample

III. RESULTS AND DISCUSSIONS

Biodiesel Yields at Different Temperatures: The results of the yield, specific gravity, and viscosity of *Jatropha* oil as affected by the different extraction methods and different etherification temperatures (60^o C, 65^o C and 70^oC) are as presented in Tables 1 and 2. The percentage oil yield ranged between 70.62 to 79.41% based on extraction methods and between 69.41 and 82.35%. The highest oil yield of the oil was found with samples C which represent the oil extracted by sand roasting, dehulling, milling, and defatting. This may be due to the fact that this treatment can be made the sample to have larger surface area than the other samples. The surface area predisposes the sample to higher rate of extraction. This is in agreement with the report of Wilson (2010) on the effects of such treatment as adopted on the yield of biodiesel production. The highest yield (82.35%) obtained from transesterification temperature of (70^oC). The trend is such that the oil yield increases with increase in temperature. This observation is in line with the finding of Freedman et al (1984) who discovered that temperature clearly influenced the yield of biodiesel and reaction rate, when they investigated the transesterification of soybean oil with methanol at various temperatures. The same trend was reported by Srivastava and Prisad (2000) and Rammesh et al (2002). The above values and comparison imply that the biodiesel produce at 70^oC have potentials to be used as a fuel for compression ignition engine in the tropics as opposed to the cold region of the world. The maximum yield which was obtained at 70^oC coupled with its determined fuel properties which are in line with what was obtained from literatures made this work to be invaluable. The specific gravity of the oil ranged between 0.904 to 0.908. The values are relatively high in all. The high specific gravity indicates mainly aromatic or asphalted fuels with poor combustion properties. The viscosity values range between 3.24 to $3.424mm^2/s$. The viscosity of *Jatropha* oil showed that the oil is sufficiently viscous as fuel for diesel engine and that real spray would generate across the combustion and

would properly mixed with air. The chemical properties of *Jatropha* biodiesel extracted under different extraction methods are as presented in Table 3. There was significant difference ($p<0.05$) with the peroxide value, pH, specific gravity, iodine value while there were no significant differences in the free fatty acid and saponification values. The low saponification value of *Jatropha* biodiesel indicated good ignition properties.
For the esterification temperatures, the specific gravity and the viscosity steadily increases with increase in the temperature. These values are generally in the consonance with oil of good characters as diesel engines. The Free fatty acids, peroxide values, saponification values, iodine values for all the samples had the lowest value with sample C (sand roasted, dehulled, and defatted jatropha seeds. These trends are equally in agreement with the report of Rasvesh et al (2002). The results of the oil yield, specific gravity, and viscosity as affected by the etherification temperature are as presented in Table 3

Table 1: Effects of Different Extraction Methods on the Yield and Some Physical Properties of Jatropha Seed's Oil

Physical Prop.	SAMPLES		
	A	B	C
Yield (%)	70.62	74.99	79.41
Specific Gravity	0.904	0.905	0.908
Viscosity	3.240	3.230	3.424

Table 2: Effects of Different Extraction Methods on Some Chemical Properties of Jatropha Seed's Oil

Chemical Prop.	SAMPLES		
	A	B	C
Free fatty acids (g/100g)	0.431[a]	0.423 [b]	0.368 [a]
Peroxide value (Meq/kg)	2.00 [a]	2.00 [a]	2.00 [a]
pH	7.38 [a]	7.42 [a]	8.50 [a]
Saponification Value (Mg/Kg)	64.80 [a]	58.91 [ab]	52.73 [b]
Iodine Value (Mg/Kg)	146.61a	143.33 [a]	140.65 [a]

Table 3: Effects of Esterification Temperature on the Yield and Some Physical Properties of Jatropha Seed's Oil

Physical Prop.	Esterification Temperature (^{0}C)		
	60	65	70
Yield (%)	69.41	75.00	82.35
Specific Gravity	0.802	0.804	0.808
Viscosity	3.450	3.490	3.510

Table 4: Effects of Different Esterification Temperature on the Yield and Some Physical Properties of Jatropha Seed's Oil

Chemical Prop.	Esterification Temperature (^{0}C)		
	60	65	70
Free fatty acids (g/100g)	0.521[a]	0.500 [a]	0.435 [b]
Peroxide value (Meq/kg)	2.01[a]	2.01[a]	2.01 [a]
pH	7.50 [a]	7.91[b]	8.04 [c]
Saponificatio Value (Mg/Kg)	65.00 [a]	63.50[b]	60.01 [b]
Iodin Value (Mg/Kg)	144.21a	142.52 [b]	141.22 [a]

IV. CONCLUSION

From the result, it can be concluded that different extraction methods and transesterification temperature have actually affected the quantity and quality of biodiesel produced from *Jatropha* oil seeds. Processing of the oil seeds by roasting dehulling, milling and defatting and transesterification at 70^0C gave the highest oil yield and the most acceptable chemical properties.

REFERENCES

1. Dagar J.C. Tomar O.S. Kumar Y. Bhagwan H. Yadavand R.K. and Tyagi N.K. (2006). Performance of
2. some under-explored crops under saline irrigation in semiarid climate in north west india. land Degradation Dev. 17: 285-299.
3. Daiziel J. M. (1955). The useful plant of west tropical Africa. Agents for overseas Governments and
a. administration, London. Journal of Biological sciences.
4. Freedman, B. Pryde, E. H, Mounts, T. L. (1984). Variable affecting the yield of fatty esters from trans
a. esterified vegetable oils, JAOCS 61:1638-1643.
5. Gour, (2006). Handbook of Bioenergy crop plant, Google book.
6. Joseph, H. (1996). Physic nut. jatropha curcas l. Promoting the conservation and use of underutilized and
a. negelected crop. Ph.D Dissertation.
7. Ramesh, D. A., Samptatraja and Venkacha .(2002). Production of Biodiesel Using Pilot Biodiesel Plant
8. With jatropha" Agricultural engineering College and Research institute Rami Nadu agricultural University.
9. Srivastava A, Prasad R, (2000). Triglyceride base fuels, Rene renew sustain energy Rev 4:111-13.
10. Wilson P. (2010). A review of Biodiesel production on jatropha curcas oil.

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